

# **Report of the Committee on the LBL Readiness Review of the KamLAND 4pi Calibration Source Manipulator System**

**Review Committee:** Bill Edwards (Engineering)  
Ron Madaras, Chair (Physics)  
Howard Wieman (Nuclear Science)

**Date of the Review:** June 7, 2005

## **Scope of the Review:**

The two main questions that were addressed in the readiness review are:

1. Is this system safe to operate and safe for the KamLAND detector?
2. Can this system adequately perform the required calibrations?

## **Agenda of the Review:**

- Presentation by Karsten Heeger describing the calibration requirements, design and tests of the 4pi Calibration Source Manipulator System.
- Demonstration of the 4pi Calibration Source Manipulator System in the Bevatron.
- Further discussion with the review committee.

## **Documentation:**

1) Web site for the KamLAND 4pi Calibration Source Manipulator System:  
<http://kmheeger.lbl.gov/kamland/4pi/>

2) Web page with material for the Readiness Review:  
<http://kmheeger.lbl.gov/kamland/4pi/reviewjune05/>

3) Karsten Heeger's presentation at the Readiness Review:  
[http://kmheeger.lbl.gov/kamland/4pi/reviewjune05/KamLAND4pi\\_LBNL\\_review.pdf](http://kmheeger.lbl.gov/kamland/4pi/reviewjune05/KamLAND4pi_LBNL_review.pdf)

## **Conclusions of the Review Committee:**

1. The KamLAND 4pi Calibration Source Manipulator System is simple and well suited to the task. This in itself generates confidence in its reliability and safety. It is a natural extension of the existing Z-axis calibration system, and this prior experience adds further confidence in the system.

2. The calibration team has successfully focused their efforts on the risk of dropping elements of the calibration system into the detector and the correct positioning of the device so that it does not compromise the liquid scintillator isolation balloon.
3. Dropping during assembly is prevented by a mechanical lock system and well defined procedures. Intermediate securing mechanisms provide redundant security in the assembly and lowering of the instrument into the detector.
4. The umbilical support lines are made up of stainless cables which have a significant load safety factor for the two sources of stress (the weight of the calibration pole and the accidental loading by the motor driven spools should the support line be inadvertently jammed).
5. Positioning of the device is handled under computer control with multiple backup sensors with cross check redundancy. Methods for manual control and withdrawal cover the credible failure modes. Operation is slow and methodical, allowing for manual intervention in case of unanticipated operation failures. Provisions have been incorporated to safely handle power and computer failures.
6. The desired positioning accuracy appears to be attainable.
7. The control software should be modified to include limits on operator controlled parameters.
8. For the commissioning and operation of the calibration system in the KamLAND detector detailed written procedures should be strictly followed.
9. The following action items, proposed by the KamLAND 4pi Group in response to the Committee's questions, should be completed before deployment of the calibration system in KamLAND:
  - 9.1 Add a latch to the Pivot Block (the device that clamps to one of the cables and allows the other cable to slide) to prevent the Block from separating from the cable if the clamp comes loose.
  - 9.2 Perform a load test of the Calibration Pole Cable Clamp and the Pivot Block when the cable is soaked with mineral oil, to see if they still have sufficient holding strength.
  - 9.3 Test the torque limit of the motor controlling the sliding cable to ensure that the motor turns off if the cable ever got stuck, and perform various tests with the cable and the Pivot Block to see if the cable can get stuck.
  - 9.4 Test the software interlocks for the case of a mismatch between the actual Calibration Pole configuration and the configuration entered in the command software.
10. The Review Committee believes that the KamLAND 4pi Calibration Source Manipulator System will perform reliably and safely for both equipment and personnel, and will provide the desired calibration improvements in KamLAND.